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ABSTRACT

This report addresses the use of computer-based telecommunications services to meet educational needs at home, focusing on services for students in grade 7 through college, including adult education. The curriculum areas on which the report concentrates are mathematics, science, technology, engineering, and career education. The report is divided into 10 sections: (1) An Overview of Telecommunication Functions that Support Educational Purposes; (2) An Overview of Service Providers; (3) Data Highway: The Internet; (4) General Purpose, Commercial Networks that Provide Educational Services; (5) Regional and Statewide Networks; (6) Library Access Networks; (7) Special Purpose Networks; (8) Bulletin Board Systems; (9) Telephone Homework Hotlines: A Model for Computer Network-Based Tutoring Services; and (10) Conclusions. The appendix contains a contact list of project consultants, online services, and homework hotline services; an annotated list of 13 additional online projects and services; and a list of additional resources, including publications and organizations, related to educational applications of telecommunications. (ALF)

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USING COMPUTER-BASED, TELECOMMUNICATIONS SERVICES TO SERVE EDUCATIONAL PURPOSES AT HOME

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USING COMPUTER-BASED, TELECOMMUNICATIONS SERVICES TO SERVE EDUCATIONAL PURPOSES AT HOME

Introduction

This report addresses the use of computer-based, telecommunications services to meet educational needs at home -- focusing on services for students in grade 7 through college (including adult education). The curriculum areas on which this report concentrates are mathematics, science, technology, engineering, and career education.

This report is divided into 10 sections:

* An Overview of Telecommunications Functions that Support Educational Purposes
* An Overview of Service Providers
* Data Highway: The Internet
* General Purpose, Commercial Networks that Provide Educational Services
* Regional and Statewide Networks
* Library Access Networks
* Special Purpose Networks
* Bulletin Board Systems
* Telephone Homework Hotlines: A Model for Computer Network-based Tutoring Services
* Conclusions

An Overview of Telecommunications Functions that Support Educational Purposes

Throughout this report, we refer to a number of functions, or capabilities, typically available on comprehensive online information services. Important online functions are defined as follows.

Electronic mail, or **e-mail:** The electronic preparation, sending, and receiving of messages, documents, or images. E-mail is generally thought to be private communication between two individuals -- the electronic equivalent of sending and receiving private letters. (In actuality, some systems require the system operator to monitor even supposedly private e-mail correspondence.)

Electronic conference or forum: An individual-to-group form of electronic communication that supports ongoing discussions or idea exchanges -- usually centered around a specific interest or topic. Electronic conferences or forums may involve simple "linear" **bulletin boards** (in which messages appear in the sequence in which they were originally posted) or complex hierarchies of discussions over time (in which sets of messages can be accessed by sub-topic). Many ongoing electronic conferences are conducted under the condition of **delayed response**, where a participant posts a message and expects to wait hours or days for a response.

Real-time communication, chat, or live-text conferencing: An online, text-based version of a telephone call, during which information is read from the screen and responses are typed, instead of voice transmission and reception. This feature can be used to connect a single caller with someone who can help solve a problem or to bring a large audience in touch with a respected expert (akin to a telephone conference call).

File transfer: The ability to transmit and exchange files, documents, graphics, or software programs. On many online systems, this is referred to as **uploading** (sending files to the system) and **downloading** (receiving files from the system).

Remote access: The ability to use your computer to connect to a second computer and use this second computer (e.g., run its software programs) as if you were working directly from it. The second computer is considered the **remote** computer.

Database access: The ability to search databases for information. Database experts often refer to four categories of retrievable data: bibliographic, abstract, full text, and quantitative. Some databases can be searched via easy-to-use menu systems. Many require prior knowledge of keywords and boolean logic. Some offer index searching capability (e.g., searching on the author's name; searching for a word or phrase in the title; searching on a category term in a field of subject headings).

Reference tools: Online reference tools such as electronic encyclopedias, online library card catalogs, electronic book reviews, and electronic indexes.

Gateways: Electronic "doors" or "portals" through which one can connect to different online systems from the one currently in use.

An Overview of Service Providers

IESD analysts have identified six broad categories of computer-based, telecommunications educational service providers:

* Data Highway
* General Purpose Commercial Networks
* Regional and Statewide Networks
* Public Library Access Networks
* Special Purpose Networks and Online Services
* Local Bulletin Board Systems

In general, these services can be differentiated by the geographic units they serve, their educational missions, the audiences they serve, and the design and technical capabilities of the systems. Each type of service is discussed below. Keep in mind, however, that the telecommunications universe is in a constant state of evolution. Online service providers regularly add offerings in the hope of attracting more users and drop features that have been underutilized. New services appear while some others disappear. The information presented in this report is up-to-date as of September 1992.

Data Highway

The international data highway, called the **Internet**, is a network of networks. It consists of multiple chains of computer networks that are linked via a common set of software protocols that allow electronic mail, file transfer, and remote access among these networks and the computers connected to them. Different computers and networks have different levels of access to the Internet. Many users have electronic mail access, which means they can send e-mail messages to any other user connected to the

Internet. Fewer networks (and, therefore, fewer users) can use the Internet for purposes of file transfer and remote access.

The Internet data highway serves many purposes (including education) and many audiences (including students). It offers great flexibility in allowing participants throughout the world to communicate and to take advantage of each others' computer-based resources. However, it was not designed with computer novices in mind and is not generally regarded as user-friendly. Navigation among the hundreds of computer hosts throughout the system can be a tremendous and not-always-successful challenge.

General Purpose, Commercial Networks

General purpose, for-profit networks are available nationwide, often through local access numbers. They are the "supermarkets" of computer-based, online telecommunications -- providing a wide array of information services (both educational and non-educational). They attract an audience with varied interests and offer online access to the greatest number of users throughout the U.S.

This type of online service is organized by topical menus and is designed for ease of use. General purpose, commercial networks typically provide all or most of these functions: e-mail, electronic conferencing, real-time communication, file transfer, database access, reference tools, and gateways to other services. Examples include Prodigy, CompuServe, America On-line, GEnie, Delphi, and U.S. Videotel. (Each of these is described in more detail below.)

Regional and Statewide Networks

Some regional and statewide electronic networks are dedicated to educational purposes, whereas others serve multiple purposes (e.g., educational and government). The content offerings typically focus on needs and resources specific to the region or state the network serves. Some restrict usage to those within regional or state boundaries.

These systems are organized by topical menus and are designed for ease of use. Most of the following functions are typically provided: e-mail, electronic conferencing, real-time communication, file transfer, database access, on-line reference tools, and gateways to other services (including region-specific or state-specific resources).

The Free-Net (Cleveland, Ohio) and Big Sky Telegraph (Dillon, Montana) systems are excellent examples of regional networks. Virginia, Texas, Florida, and North Dakota have statewide systems that serve educational purposes. (Specific networks are described in more detail below.)

Library Access Networks

Some public community library systems and research libraries at post-secondary education institutions offer online card catalogs and/or reference services. A few such systems are described below.

Special Purpose Networks and Online Services

Some networks and online services are dedicated to a specific role, mission, or target audience. These can be state, regional, national, or international in orientation. Their design and capabilities vary, depending on the purposes and audiences for which they are intended. Examples include Learning Link (education and public television offerings), NASA Space Link (data related to the U.S. space program), EcoNet (ecological issues), and Dialog (database searching), and higher education networks and online services. (Several special purpose networks and services are described in greater detail below.)

Local Bulletin Board Systems

A bulletin board system (or BBS) is a small-scale computer network that serves a specific local community. BBSs are typified by limited access and limited data storage capability. Some BBSs are strong in educational content, and others are not.

A BBS is organized by topical menus and is designed for ease of use. A BBS most often provides e-mail, electronic conferencing (usually the linear variety), and file transfer functions to its users. A growing number of BBSs provide the ability to connect to users on other BBSs through the Internet (but connection to the Internet is usually transparent to the user).

Data Highway: The Internet

The potential uses of the Internet data highway are many -- perhaps overwhelming -- and include: long distance communication and collaboration; access to remote computers and networks for the purpose of accessing or sharing software, text documents, and electronic books and journals; access to databases and online library catalogues; access to "distance education" -- electronic "correspondence schools" that afford real-time, interactive contact with teachers and fellow students in "chat" mode; even access to supercomputers.

One important source of text-based educational information is the Internet's USENET service -- a massive collection of topic-specific forums in which participants can send and receive news, debate issues, ask questions, and provide answers. Another valuable source of topic-specific forums is the LISTSERV service of BITNET (Because It's Time Network) -- a network of university computers; Internet users can access BITNET through several gateways. In addition, the United Kingdom's Joint Academic Network, also known as JANET, is now available for limited information access via the Internet.

Home access to Internet e-mail is readily available via several of the networks described throughout this report. However, student home use of Internet resources requiring file transfer or remote access is usually limited to those enrolled in an educational institution directly connected to an Internet host computer (true of many major universities), those in states where free or low cost dial-up access is available (e.g., Virginia), and students related to others who have official dial-up Internet access (e.g., children of university professors and professionals at high technology companies). Once on the Internet, access to specific resources may be free of charge, available on a fee basis, or restricted to members of specific organizations.

In this section, we present a sampling of specific resources available via the Internet of potential interest to students in grades 7-college in the areas of math, science, technology, engineering, and career education. (However, keep in mind that many resources available on the Internet were not originally created with students in grades 7-12 in mind.) Most of the resources listed below have been culled from available Internet resource guides (Kochmer, 1992; Kehoe, 1992) and from preliminary Internet exploration. These guides provide information for accessing the sources.

Mathematics

Resources and topics include:

Maple mathematical software tools (Maple FTP Archives)
Mathematica mathematical software tools (Mathematica FTP Archives)
Mathematical source code and algorithms (Netlib Mathematical Software Distribution System)
Mathematics bulletin board articles (a variety of areas within higher mathematics)
Mathematics discussion groups (a wide selection focusing on a variety of areas within mathematics, including American Mathematical Society)
MATLAB numeric computation system functions and utilities (MATLAB User Group Archive)
Science, math, and engineering education (discussion group)
Statistics (software, algorithms, and information from Statlib Statistical Software and Data Distribution System; bulletin board articles)

Science

Resources and topics include:

Albert Einstein's Writings (discussion group)
Chemistry (software from the IuBIO-Indiana University Archive for Molecular and General Biology; bulletin board articles)
Earthquake information
Ecology and Environment (simulation models from CEAM-Center for Exposure Assessment Modeling; student environmental activitism discussion group; planetary ecology discussion group; bulletin board articles)
Genetics and Molecular Biology (LiMB Database-Listing of Molecular Biology Databases; Bibliography of Theoretical Population Genetics; ENZYME-Dictionary of Enzymes; software from the IuBIO-Indiana University Archive for Molecular and General Biology; Johns Hopkins Genetic Databases; PROSITE-Dictionary of protein sites and patterns; SEQANALREF-DNA sequence analysis bibliography; SWISS-PROT - Protein sequence data bank; Genetics Bank; Human Genome Mapping -- discussion group)
Meteorology (data topic on the University of Maryland Info Database; University of Michigan weather database)

NASA, space, and astronomy information (NED-NASA / IPAC Extragalactic Database; NASA SpaceLink; NASA Headline News; Yale Bright Star Catalog; U.S. Naval Observatory Automated Data Service database; NSF/SpaceMet Telecommunications Network; space-related bulletin board articles; Project Zero-G -- project involving the redesign of aspects of everyday life for orbiting space stations)
Oceanography data (Oceanic Information Center)
Physics (High school physics discussion group; Newton -- a physics BBS; bulletin board articles; a physics students discussion group)
Public Domain and Shareware Software (Washington University Public Domain Archives)
Science articles and bibliographies ("F.A.S.T. News" -- electronic journal)
Science awareness and promotion (discussion group)
Science discussion groups and bulletin board articles (a wide selection focusing on a variety of areas within science)
Science, math, and engineering education (discussion group)
Science publications (full text) from the National Science Foundation (Science & Technology Information System database)

Engineering

Resources and topics include:

Aeronautics bulletin board articles
Marine studies (Ocean Network Information Center database -- University of Delaware College of Marine Studies)
Science, math, and engineering education (discussion group)

Technology

Resources and topics include:

Computer-based communication: legal and policy issues ("Effector Online" -- electronic journal)
Computers (data topic on the University of Maryland Info Database)
Computers: hardware and operating systems (discussion groups)
Information and discussion groups about the proposed National Research and Education Network (NREN)

Information technology: social and ethical concerns ("Impact Online" -- electronic journal)
Public Domain and Shareware Software (Washington University Public Domain Archives)
Robotics (discussion group)
Source code for most brands of personal computer (useful in the development of new software)
Technology articles and bibliographies ("F.A.S.T. News" -- electronic journal)
Technology discussion groups and bulletin board articles (a wide selection focusing on a variety of areas within technology)
Technology publications (full text) from the National Science Foundation (Science & Technology Information System database)
Use of computing in education ("Currents" -- electronic journal; discussion groups)

Career Education

Resources include:

Articles and brochures on jobs ("PENpages" database from The Pennsylvania State University)
Higher education admissions information and advice to high school students (Liberty High -- a component of NYSERNet's "Bridging the Gap" program, which focuses on connections between K-12 and higher education institutions)
Job listing related to technology and science ("F.A.S.T. News" -- electronic journal)
Scholarships, fellowships, and grants available at historically Black and Hispanic colleges and universities (FEDIX -- Minority On-Line Information Service)

This is far from a comprehensive listing of services. Indeed, one of the great challenges of the Internet is locating all the educational resources that meet one's interests and needs.

General Purpose, Commercial Networks that Provide Educational Services

IESD analysts have identified five general purpose, commercial networks that provide educational services appropriate for some or all of this study's target population:

* Prodigy
* CompuServe
* America On-line
* GEnie
* Delphi

Each of these are described in detail below.

A sixth commercial network, U.S. Videotel, has operated as a south-western U.S. regional service but is about to go national. It offers a range of services similar to other such networks, including databases, e-mail, bulletin boards, chat, and online clubs. However, according to their representative, U.S. Videotel's educational offerings are more appropriate for grades 3-6 than for the grade 7-college range.

Prodigy

Prodigy has one of the largest base of home users of any national, commercial network. (They report to have over one million users). It offers educational resources to students that include: e-mail, technology forums (electronic conferences), and database access. The educational features are generally more appropriate for grades 7-12 than for post-secondary education. One important limitation of Prodigy is that it does not yet provide file transfer capability as part of its e-mail system. (They have provided file transfer for a few special projects unrelated to education. It is reasonable to assume that file transfer may become a regular system capability eventually.)

Prodigy is particularly well known for its excellent online reference resources (including an encyclopedia, weather data, and news), educational games, and topical bulletin boards. However, some promising "educational" items in the Prodigy index are actually opportunities to purchase products or services. (In addition, advertisements appear

on each and every Prodigy screen, which may be a distraction for some users.)

One resource that is highly appropriate for grades 7-12 is the Science Center, which includes activities and information supplied by NOVA (the WGBH - Boston public television science series) and National Geographic. Every month, NOVA offers a featured science topic. (For example, a recent topic was Plate tectonics and convection.) An interactive computer tutorial is presented, as is a lab experiment students can conduct on their own. All past labs and tutorials are available, as well. NOVA also provides virtual trips and text-based "lectures" by science experts. Each month, National Geographic presents an interactive simulation in which students engage in role-playing and conduct detective-like investigations, including map interpretation. Other Science Center offerings include science news and a library of interesting science articles.

Prodigy also includes a computer club, which may be appropriate for some students in grades 7-12.

Basic service is provided at a flat monthly rate of $12.95 plus tax (due to increase to $14.95 plus tax as of November 1992), and all educational features are covered by it. The flat rate covers the first 30 e-mail messages sent, with a surcharge of 25 cents for each message sent after the first 30.

CompuServe

CompuServe is another national/international commercial network with a large user base. (They report over 900,000 online users.) Due to its wide range of features and services, and its variety of users, CompuServe serves as a unique research community for personal educational benefit. Students using CompuServe can link with scientists, mathematicians, and other experts via the extensive forums or bulletin boards available. (Contacts made within forums can be continued on a one-to-one basis via e-mail.) Forums of potential interest to students focusing on math and science include:

Aquaria Fish
Astronomy
Cancer
Diabetes
Health and Fitness
Human Sexuality
MENSA (development of human intelligence)

Network Earth (solving environmental problems)
Science/Math Education
Space
Student (a means for students to communicate with other students)

For students interested in technology, Compuserve offers comprehensive forum support for products from major computer hardware manufacturers and software publishers. In addition, some content areas within technology are supported by forums, many of which are run by technology publications. Content areas include:

Artificial Intelligence
Computer Languages and Software Development Tools
Computer Graphics
Computer Viruses
Databases
Desktop Publishing
Multimedia
Telecommunications

Students can search for information on colleges and can investigate career choices by means of databases or exchanges with actual individuals in those fields.

Students can access a variety of databases to retrieve full text or abstracts of articles from magazines, journals, and other publications for research projects or interests. For instance:

Acquired Immune Deficiency Syndrome (AIDS)
Computers
Dissertation Abstracts
Engineering
ERIC (Educational Resources Information Center)
Gateways to popular comprehensive database services (e.g., DIALOG)
Health
Human Sexuality
Medicine, Sports Medicine, Rare Diseases
Newspapers and Newswires
PsychINFO (Psychological Abstracts)

CompuServe offers multiple sources of weather data, including downloadable weather maps and continuously updated aviation weather data.

While CompuServe offers a large downloadable software exchange, the available educational software is of the tutorial and drill game types, and is generally of low quality -- typical of much public domain software.

Under development as of August 1992 is Project CAREER (CAReer Exploration through Electronic Resources), under the direction of Creative AdVentures in Education (CAVE), the nonprofit organization that operates CompuServe's Education Forum. (While initial development is for the CompuServe network, CAVE has expressed an interest in making Project CAREER available via the Internet and other online systems, including Prodigy, GEnie, and America Online.) This project will enable young adults to link up with online mentors, query experts in fields of interest, and discuss careers via electronic conferences and e-mail.

According to current plans, each week students throughout the U.S. will be invited to participate in one or more online conferences. Each conference will feature a special guest "speaker" -- a successful professional who will "talk" to the students about the challenges and rewards of his or her chosen career. Students will be able to type questions to the guest about his or her work and learn more about the profession's educational and skill requirements. Students with a special interest in the guest's career will be encouraged to continue personal communication via e-mail and to conduct further research by accessing online databases.

The developers of Project CAREER envision that it can enable exploration in a broad range of professions or can serve more focused exploration related to specific curriculum areas. In a downloaded electronic conference document, CAVE representatives provided an example for math and science:

> ...we can foresee guests/mentors who are astronomers, aerospace engineers, electronic engineers, environmental scientists, and so on. Young people who are stereo buffs and music enthusiasts may perhaps be inspired to become electrical engineers who design audio equipment. Youngsters who enjoy fast cars may wish to become automotive engineers. Students who like to surf and water ski might choose to study oceanography or marine biology.

CompuServe is available at either a flat monthly rate of $7.95 or an hourly rate that ranges from $6.30 to $22.80 (the faster the modem speed, the higher the hourly rate). However, the most desirable educational features are available only at the hourly rates, and many of the

databases require a surcharge beyond the basic hourly rate. Surcharges vary widely from database to database.

America Online

America Online is a commercial network offering similar features to other such networks. They report approximately 180,000 subscribers. Academic assistance is a high priority for this network, and its educational services are highly appropriate for grades 7 through college. Students using this service can access online experts, topical discussions, news, an electronic encyclopedia, and databases providing information about colleges.

An entire section of the America Online system is dedicated to education and reference. Educational services include the following:

Interactive Education Services: These include online, real-time courses in algebra, calculus, geometry, physics, biology, electronics, computer science; online university courses; information related to professional studies; and a clearinghouse of general educational information of interest to parents and students. (NOTE: America Online plans soon to restructure its main menu -- presenting the post-secondary educational offerings as a separate **University Connection** main menu selection. It is actively seeking out additional universities to participate in offering online curricula.)

Academic Assistance Center: This section includes subject specific lessons, real-time tutoring, the ability to page a teacher for one-on-one homework help, a study skills service, help in preparing for end-of-term exams, and an online research service administered by a professional research librarian. Turn-around time for homework-related inquiries is 48 hours or less. Turn-around time for research inquiries is 72 hours or less.

Career Center: This section includes a "talent bank" of job seekers, resume templates, a cover letter library, a self-employment service, a federal careers database and related resources, a career research library, career and employment related databases, and career counseling.

In addition, the following features might be of interest to students:

Astronomy Club
College Board Online
Computing and Software
Dictionary of Computer Terms
Environmental Club
Home Schooling
Math Education
National Geographic Online
National Space Society
Parent Information Network (also includes information for students)
Public Domain Educational Software (MS-DOS, Apple II, and Macintosh; downloadable free of charge)
Science Education

A few America Online services are provided at a flat monthly rate ($7.95 for MS-DOS computers; $5.95 for Macintosh computers), and the flat rate is waived for the first month. Most features, including the most desirable educational features, are offered at an hourly rate ($10.00 during prime time, 6 a.m. to 6 p.m. weekdays; $5.00 during non-prime time) above the monthly rate. MS-DOS users are given five free hours during their first month and two free hours during their second month. Macintosh users are given one free hour each month. All free hours are for non-prime time usage.

GEnie

GEnie is a national electronic mail network with gateways to databases and electronic bulletin boards. They report 330,000 subscribers. The educational feature most worthy of note is the Computer Assisted Learning Center (CALC), which includes:

> **Real-time tutoring and homework help:** Students can work with live tutors in "chat" mode on a drop-in or scheduled basis. Tutoring hours for different subject areas are posted in advance.

Real-time structured courses: Live teachers conduct scheduled courses, some of which are available for college credit applicable to Associate's and Bachelor's degrees. Curriculum areas include Computer Science and Electronics, Mathematics, and Science. Each course comes with its own private course bulletin board, where the teacher's instructional notes and answers to student questions are posted. Course materials are downloadable from online materials libraries.

Tutoring Center bulletin board: Students can post curriculum-oriented queries during hours when real-time tutoring is not available. (The bulletin board is regularly monitored by teachers.) In addition, students who attend scheduled real-time tutoring sessions can access teacher summaries of these sessions.

Reference Center: This service offers automated, online database searching.

Career and academic counseling

Public domain education software library: Students can download and upload software. Software quality is typically not up to commercial standards.

Other features appropriate for students include:

Computer Game Design Roundtable (conference)
Computers and Technology
Education Bulletin Board
Education Roundtable (conference)
Encyclopedia (online)
Home Automation Bulletin Board
Medical Bulletin Board and Database
News
Radio and Electronics Bulletin Board and Roundtable (conference)
Renssealer Polytechnic Institute Bulletin Board
Spaceport Bulletin Board
Telecommunications Roundtable (conference)
Weather

For students interested in technology, GEnie offers forum support for products from major computer hardware manufacturers and from some software publishers. However, the coverage is not as comprehensive as that provided by CompuServe.

Genie offers a body of basic services for a flat non-prime time fee of $4.95 per month. However, the most valuable educational services (e.g., CALC) require additional hourly connect charges ($6 for most users; $18 for high speed, 9600 baud modems). During prime time (8 a.m. to 6 p.m. weekdays), the hourly connect rate is $18 for most users and $30 for 9600 baud modems. Attending college courses for credit requires a registration fee of $25 to $50 per course. Accessing the Reference Center requires surcharges of $1.25 to $4.50 (depending on the service).

Delphi

Delphi is another commercial, general purpose online service with a limited set of educational features applicable. (They would not divulge the number of subscribers.) Its features include: e-mail, technology forums (electronic conferences), and database access.

Delphi has a dedicated section, SCHOLE, for information services related to college students. One interesting feature is called Students and Sages, where students identify themselves as such and ask questions -- in an effort to attract a **sage**, or mentor, who can help answer the question. There is also a Learning Centers feature, which currently provides information about Boston University but is soliciting for other higher education institutions to become information providers.

Other features of potential interest to students include:

CAIN (Computerized AIDS Information Network)
Environment Special Interest Group Forum
Gateway to DIALOG (extra fee)
HealthNet (medical information)
Online encyclopedias
Online research service (extra fee)
UPI News

Delphi offers two payments plans. The basic plan costs $10.00 per month and includes four hours per month of non-prime time usage; additional non-prime time hours cost $4.00 under this plan. The 20/20 plan costs $20.00 per month and includes 20 hours per month of non-prime time usage; additional non-prime time hours cost $1.80. There is a $9.00 per hour surcharge for prime time usage (6 a.m. to 6 p.m.) Some services (noted above) require additional fees, and these vary widely.

Regional and Statewide Networks

In this section, we highlight several regional and statewide networks that provide educational services with potential benefit for students in grades 7-college.

Free-Net

Free-Net is a community-based network available in various regions of Ohio and Illinois. Free-Net offers students a full range of electronic services, including electronic mail, bulletin boards, a daily electronic news service (USA TODAY); "chat" and conferencing services, and real-time connections to other computer systems around the country -- including major online library card catalogues.

The major advantage of this system is that it is available free of charge in the communities it serves, since it is funded by grants, foundations, and volunteer user support. The original Free-Net was developed in Cleveland by the Case Western Reserve University Community Telecomputing Laboratory.

Free-Net's menu structure is based on a "city" metaphor to make it easy for users to travel from "place" to "place" within the system. For example, students can select the Courthouse & Government Center (to access legal and government information) or the Science and Technology Center (to access information and forums on science and technology). Features of potential interest to students include:

- Academy One (information resources related to local school-based telecommunications projects)
- Access to local area universities and a statewide research network
- Bioethics Network of Ohio
- Computer Corner
- County Engineer's Office
- IEEE (Institute of Electrical & Electronic Engineers)
- Jobs Wanted/Jobs Available
- Library Resources (including online electronic reference works, and access to public and university-based research libraries)
- Medical News and Resources
- Museum of Natural History
- NASA Air and Space Special Interest Group (SIG)
- Safety and the Environment
- Science and Technology News

Skeptics SIG (for those skeptical of technology's benefits)
Solid Waste SIG
U.S. National Weather Service

Free-Net systems provide one excellent model for using telecommunications for home-based educational purposes because they are free of charge (to the user), take maximum advantage of local information and communication resources, and also provide access to other such systems. (Also see the section on the National Public Telecomputing Network, below, which is attempting to make the Free-Net model available throughout the U.S.)

Free-Net Affiliates and the National Public Telecomputing Network (NPTN)

The National Public Telecomputing Network (NPTN) is an outgrowth of Case Western Reserve University's research related to the original Free-Net system. NPTN is now assisting in the development of free, open-access, community Free-Net systems in cities throughout the U.S. and abroad.

To this end, NPTN makes available the technical expertise and software necessary to develop and operate community computer Free-Net systems virtually anywhere. The NPTN software is being made available to qualified parties on a lease basis for $1 per year.

Newly formed local Free-Net "affiliates" will operate much like their Ohio progenitors. They will be linked to other Free-Nets by e-mail and by common programming, called **cybercasting**.

An example of an NPTN-assisted Free-Net affiliate is Heartland Free-Net, serving the Peoria County, Illinois area. Heartland Free-Net is sponsored by the Peoria County government, and locally-based corporations and non-profit organizations. This system's information and communication offerings closely resemble those of the original Cleveland Free-Net -- with some notable additions:

Education Center (with separate "places" for elementary school, secondary school, local post-secondary schools, and an educational projects center)
Educational Information and Opportunities for Senior Citizens
Environmental Information
Government-sponsored job service

Science and Technology Center "place" for those interested in aviation, space, and astronomy
Teen Center (including online rap sessions)

If successful, an NPTN-assisted system of Free-Nets could become the telecommunications equivalent of National Public Radio or the Public Broadcasting Service.

Big Sky Telegraph (Western Montana College)

The Big Sky Telegraph project operates as a bulletin board system and software archive accessible by 116 one-room schools and numerous private citizens throughout rural Montana and neighboring areas. While school use dominates the system, innovative online training for pre-college, vocation preparation is periodically provided to individuals as well. The system also supports agricultural databases and telewriting activities related to the U.S. Forest Service.

Big Sky Telegraph consists of five separate "systems," all residing on the same host computer, and all having features appropriate for students:

Rural education and online classes
Western Montana College activities, clubs, and classes
Community services (also including rural economic development)
Rural peer counseling
Computer conferencing with connections to the Internet and national networking systems.

Other features of potential value to students include:

Community Medical Clinic
E-mail
Educational database access
Electronic newsletters
Information on national and international electronic networking
Information on national education resources
International educational projects (via the Internet)
News
Online library services (access to Western Montana College's research library, Montana interlibrary book loans, searches for journal and magazine articles, ERIC educational database searches)
Public domain software (downloadable free of charge)

Science and math teaching ideas (intended for teachers but available to students and parents involved in home schooling)
Science essays, ideas and experiments
Technical and educational support
Telecommunications lessons

The complete set of offerings on Big Sky Telegraph changes over time. For example, MIT's Plasma Fusion Lab has previously delivered a high school level, chaos-theory course for gifted science students. A local Women's Center received funding for homebound women to receive technology training at their homes or places of work using loaner computers and modems. A public affairs officer for the U.S. Forest Service learned online telecommunications via Big Sky and then created an electronic conference on conservation with participation from the Forest Service, loggers, conservationists, and Earth First (an environmental activist organization).

Big Sky Telegraph also enables local community bulletin board systems throughout the Rockies to be linked to each other, and to national and international networks of bulletin boards -- to share mail and files. Big Sky provides e-mail exchange via the Internet and the Montana Educational Telecommunications Network (METNET), and will soon link to the Montana University System Network (MUSENET).

Big Sky Telegraph operates from Western Montana College under a major grant by US West and the Murdoch Trust, and is supported by user charges. Most services are free. E-mail and Internet access require a $50.00 annual fee (with group rates available).

Statewide Educational Telecommunications Networks

Most states have developed or are developing their own statewide telecommunications networks that serve educational purposes. Many initially focused on administrative communication among educational and related agencies within the state, but a few have branched out to provide instructional services as well.

Most K-12 student access to these networks occurs within schools. However, in a few states, it has been possible for students to access educational services at home, sometimes on an unofficial basis. Students at major public and private colleges and universities often have dial-up access to their institutions' mainframe computers, which typically

provide access to the statewide higher education network, if one exists. Four statewide systems are highlighted below.

North Dakota: SENDIT and the North Dakota University System. North Dakota has two statewide educational telecommunications networks: SENDIT for K-12; and the North Dakota University System (NDUS), serving 11 campuses. Both are funded by the North Dakota state legislature and are free to users.

SENDIT is sponsored by the North Dakota Educational Telecommunications Council and is supported by North Dakota State University at Fargo, North Dakota. The system is intended for North Dakota K-12 students, educators, and parents.

SENDIT features of interest to students include:

- Classroom Projects (provided by other network services accessible via the Internet)
- Cleveland Free-Net access
- Computer Literacy Forum
- DEONEWS (Distance Education Online)
- Discovery Channel Viewing Guide
- Junior and Senior High Chat Areas
- Library access (a variety of public and university research online systems)
- Math Forum
- NASA News and Spacelink
- Online Discovery - Astronomy, a six-week online course, during which students build their own telescopes
- Science Forum
- TAG Forum (Talented And Gifted)
- TAG - L (Talented And Gifted international forum)
- Technology Forum
- Weather Data

Additional SENDIT services that are due by early Autumn 1992 include:

- Information on course offerings
- Link between educators and homebound students
- Online homework help (all grade levels)
- Online transfer of high school transcripts to colleges
- Online transfer of transcripts among different colleges
- Online tutoring
- Peer counseling by graduate counseling students

NDUS provides local telephone access to all registered students, including non-matriculating students. Courses in agricultural science, computer science, and physics are partly taught online. In addition, the following online utilities are available to students:

- Computer-based simulations in computer science and chemistry
- Database software
- Internet access
- Library access (including NDUS university libraries and the ERIC educational research system)
- Linear programming languages
- Software compilers
- Statistical software packages

Virginia: Virginia Educational Research Network (VERNet) and Virginia Public Educational Network (VA.PEN). Virginia has two statewide educational telecommunications networks: VERNet for higher education and VA.PEN for K-12 education. VERNet links most major public and private colleges and universities together and provides unrestricted Internet access. (Complete interconnection should be accomplished by Fall 1992.) In addition, most of the larger higher education institutions throughout the state offer local dial-up access to their host computers, enabling students to access the Internet from home as well.

While VA.PEN is primarily accessed within K-12 school facilities, students in grades 6-12 can have their own home accounts, free of charge, after completing an application form that must be signed by both a parent and a teacher. The application obligates parents and teachers to supervise student use of the system.

Features of potential educational value include:

- Cleveland Free-Net access
- Curriculum-based discussion groups (read-only access for students)
- E-mail
- Internet access (complete and unrestricted access to date; VA.PEN may have to move to restricted access if independent student use increases)
- NASA Space Link
- News
- Student "chat" (in the planning stage)
- Study skills lessons

Homework help is not currently part of the system. However, the VA.PEN administration is open to providing such a service in the future. Real-time communication will be available throughout VA.PEN as of Fall 1992, making online interactive homework help technically feasible.

Texas Education Network (TEnet). TEnet is Texas's statewide computer network, funded by the state legislature. While primarily used by schools and colleges, until this year the network has also been available to homes for a flat rate charge of only $25 per year. While students have not been allowed accounts on the system, they have had access through their parents' accounts.

The system offers features such as electronic mail, online simulations, bulletin boards, collaboratively-built databases, database information, and access to the Internet. Home use has been higher than expected, unfortunately resulting in busy telephone access lines and Internet access ports, and a shortage of hard disk space. Due to state government budget restrictions, the system is not being upgraded to accommodate all who want access. The administrators of the network are debating whether to discontinue parent home accounts.

Florida Information Resource Network (FIRN). FIRN's original purpose was to provide networking for educational administrative data. This year it has branched out to provide instructional support targeted for K-12 and is intended to be used at school under the guidance of a teacher. The network is free to schools throughout Florida. Approximately 95 percent of the instructional use is at the K-12 level. However, several services are highly appropriate for post-secondary students.

Services of potential value to students include:

- Cable in the Classroom (listings of educational TV available on public and commercial cable TV)
- Career and post-secondary education information (data specific to Florida)
- Conferencing for gifted students
- E-mail
- Internet e-mail
- Online advisement and support for home-bound and hospital-bound students

Real-time communications facilities for gifted students
Research Library Access (Florida State University online card catalog system and ERIC resources; separate community college library system access is under development)
Weather maps (updated daily)

Most student use of the system occurs at an educational institution, and most cannot independently acquire an account. Home-bound and hospital-bound students are notable exceptions. General student access at home is not in FIRN's current planning.

Other statewide systems. Other statewide systems with long experience in educational telecommunications and resources of value to students include:

University of Alaska
University of California
MERIT (Michigan's higher education network)

Library Access Networks

In this section, we describe one statewide library access system (Colorado Alliance of Research Libraries, or CARL) and three local libraries that offer online card catalogue access.

Colorado Alliance of Research Libraries (CARL) Online Library System

CARL offers online access to:

Card catalogues from a variety of public, and college and university-based libraries (mostly Colorado)
Card catalogues from government libraries
Department of Energy database
Encyclopedia
Environmental Education database
Gateways to public and university library systems throughout the U.S.
General and education-oriented article databases (Magazine Index and ERIC)
Internet Resource Guide
"Uncover" document retrieval service providing access to and delivery of articles (fee-based)

CARL's card catalogue and gateway services, and access to several government databases are free of charge. Access to some proprietary databases (e.g., Magazine Index) is restricted to Colorado residents. Access to the "Uncover" document retrieval service costs $900.00 per year for a single-user password, which would be prohibitive for most home users. However, a network that is part of the Internet can subscribe to "Uncover" for $5,000.00 (for multiple-user gateway) or $10,000 (for a customized multiple-user gateway) per year. Typically, users of such networks are given free access. The average additional cost of obtaining full text research articles is $9.00 to $12.00 per article.

There are hundreds of other major research library systems that, like CARL, offer Internet-accessible online catalogs, including systems of several major public universities (e.g., University of California; major branches within the State University of New York system).

Regional Public Online Library Systems

To provide a sense of the features of regional public online library catalogue systems, IESD analysts sampled three such systems:

* Multinomah County (Oregon) Central Library
* Discovery Place, Columbus (Ohio) Metropolitan Library's On-line Catalog
* Indianapolis (Indiana) Public Library

All are menu-based systems that enable users to search for library resources by:

Title (keywords or exact title)
Subject (keywords or exact subject)
Author's name

Results of the search come in the form of bibliographic data for information resources in the library collection that match the search criterion, along with each source's current status (e.g., currently available; due on a specified date). The Indianapolis system includes the multimedia resource catalogue of the Indianapolis Children's Museum, in addition to traditional print resources. Some systems permit users to place a hold on an information resource online.

Special Purpose Networks

In this section, we describe selected special purpose network services that provide educational resources.

Learning Link

Learning Link was initially developed in New York to make it easy for K-12 educators to integrate local public television program offerings into the curriculum. It has expanded to serve as an information and communication network for both teachers and students. The model developed in New York has been installed in several other cities as well, with an initial technology investment made by the local public television station.

Learning Link services are presently heavily weighted toward teachers. However, the system is expanding its features intended for students and has created a separate main menu for student services. Features of New York Learning Link of potential interest to students in grades 7-12 include:

- Antartica (data and activities)
- Curriculum Connection (a database of instructional television programs searchable by curriculum interest and grade appropriateness)
- E-mail
- Environmental data and activities
- Gateway to online database searching (additional fees required)
- Internet e-mail
- Student File Libraries (libraries of downloadable text and graphics files, some of which relate to science)
- Up Up & Away Rocket Club (data and activities on rocketry)
- Young Astronauts Forum (including references to information on space exploration)

In addition, many of the teacher materials available throughout Learning Link are potentially valuable to parents engaged in home schooling.

In most Learning Link communities, access accounts are free of charge (i.e., subsidized by the local public television station); the maximum charge in any community is $50 per year for an individual account. For communities that do not have a local Learning Link service, there is a similar national service, called IntroLink. IntroLink is available on a yearly subscription basis with a variety of payment options.

NASA Space Link

NASA Space Link is a free-of-charge, open access, comprehensive depository of information on the U.S. space program. It is accessible via the Internet and many other online networks.

Virtually all of NASA Space Link's features are appropriate for students. These include:

- Aeronautics
- Classroom Materials (intended for educators but of value to some students as well)
- Current NASA News (including status reports on a variety of NASA projects)
- History of Space Exploration
- NASA and its Centers (information on NASA as an organization)
- NASA Educational Services (intended for educators but of value to students as well)
- Shuttle Program and the Future of U.S. Space Exploration
- Space Program Spinoffs/Technology Transfer

EcoNet

EcoNet is a telecommunications network focusing on ecological information and issues, developed by the Institute for Global Communications, a division of the Tides Foundation. It is the official network for both the North American Association for Environmental Education and the Alliance for Environment Education. It offers e-mail, as well as public and private conferences. Online database access is in development.

Conferences of potential interest to students include:

- Agriculture
- Appropriate Technology
- Climate Change
- Energy
- Environment-related Jobs
- Forest
- Marine
- Water
- Wildlife

Last year, EcoNet held an online "dialog" among children ages 10-15, encouraging them to think about and discuss their future.

EcoNet is also the network home of the Technical Education Research Center's (TERC) "Global Laboratory" project, the goal of which is to:

> ...improve science education by involving students at the secondary and college level throughout the world in scientific collaboration in global ecological research.[1]

This project involves students, teachers, and professional scientists and engineers. The network is used for information exchange. While this project is essentially school-based, students can continue project-related telecommunications at home because EcoNet provides local dial-up access.

Access to EcoNet costs $15.00 for initial sign-up and a $10.00 per month service charge. In addition, users are charged $10.00 per hour during prime time (7 a.m. to 6 p.m.) and $5.00 per hour during non-prime time.

Dialog Information Service: Knowledge Index

The Dialog online system offers the most comprehensive array of searchable databases available in the U.S. Knowledge Index is a subset of these databases, intended for home users. Knowledge Index is available only outside of normal business hours -- after 6 p.m. and on weekends. Searches can be conducted via a menu system, using keywords and boolean logic, or by index searching.

Clusters of databases of potential value to students include:

Bibliographic References (2 databases)
Chemistry (8 databases)
Computers and Electronics (10 databases)
Medicine, Drugs, and Biosciences (21 databases)
News and Current Affairs (45 databases)
Science and Technology (11 databases)

There is significant overlap in the databases included within the categories listed above. (For example, MATHSCI, a database of mathematics and science articles, is grouped within Computers and Electronics and also within Science and Technology.)

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1. EcoNet fact sheet received by fax transmission, May 1, 1992.

In addition to these clusters, there are general reference databases of potential value when conducting research in mathematics, science, technology, engineering, and career education (e.g., DISSERTATION ABSTRACTS, MAGAZINE INDEX, PETERSON'S COLLEGE DATABASE, PETERSON'S GRADLINE).

Knowledge Index is available at a fixed rate of $24 per search hour (40 cents per minute), which includes network connection and data output.

Higher Education Networks

Many colleges and universities have their own computer networks, some of which offer dial-up access to students. IESD analysts have identified several examples of innovative applications of such networks to offer educational services to students away from campus. In addition, we describe one networked-based alternative to traditional institutions of higher learning.

Texas A & M. This institution has developed a sophisticated system for delivering academic tutoring and advisement to student athletes when they are away from campus during sports competition. (Such services became an NCAA requirement for Division I schools as of 1991.) Traveling with the team is an academic advisor and laptop computers, outfitted with wordprocessing and communications software, and modems. Students connect to the university network via long distance lines and a telephone credit card. Students taking mathematics, science, and engineering courses can access practice programs and chapter outlines, can deliver assigned papers electronically, and can access the online library catalogues at Texas A & M and the University of Texas at Austin. They can also schedule times to receive real-time online tutoring, using the network's chat capability. In addition, student athletes are organized in study clusters, with students from different sports in the same cluster; when a student athlete is on the road, s/he can contact and receive help from other students in the study cluster. There are some mathematics, science, and engineering majors among the student athletes.

Cornell University. This university offers dial-up (and on campus) access to a unique career information service on the university computer network. Career guidance comes in the form of Auntie Em, an ongoing electronic dialog between students with career questions and an anonymous member of the university Career Center staff who plays the continuing role of a kindly and all-knowing (at least about career questions) Auntie. This service is a spin-off of Cornell's longstanding, online, psychological counseling service, called Uncle Ezra.

Georgia College. Education students (including prospective math and science teachers) have dial-up access to EduNet, a resource on PeachNet, the Georgia network for higher education. While students are engaged in student teaching and on through the first few critical years as novice teachers, EduNet provides access to the Georgia Quality Core Curriculum, sample lesson plans, a curriculum-to-textbook matching service, and e-mail communication between students and professors.

El Paso Community College (TX). This community college of approximately 25,000 students located near the Juarez, Mexico border is a feeder institution to both the University of Texas at El Paso and the University of New Mexico. The college has its own network that provides access to the Texas Higher Education Network (THEnet) and the Internet. Dialup access to the college library is available throughout metro area. Starting in the fall, Allied Health Services students will have access to health professions training software (from a local hospital) via dialup.

Connected Education, Inc. This organization offers network conference-based academic courses for college and graduate level academic credit, in affiliation with The New School for Social Research and Polytechnic University of New York. (In fact, the computer conferencing facility is provided by the New Jersey Institute of Technology.) The New School offers a complete online masters program in Technology and Society.

Over a pre-scheduled period of time, students access course reading material and respond in "writing" to the material and any previously-posted student reactions to it. The instructor is the last person to react, summarizing the themes that evolve from the ongoing discussion. Students participate from throughout the U.S. and several other countries.

Online courses offered through The New School include:

Applications in Telecommunications
Artificial Intelligence & Real Life
Computer Conferencing
Microchip Economy
Philosophy of Technology
Technological Forecasting

There is a registration fee of $20.00 for undergraduate courses and a per-course charge of $1179.00. The registration fee for graduate courses is $60.00 and a per-course charge of $1248.00

Bulletin Board Systems

Virtually every community throughout the U.S. with a population of 20,000 or more has free access bulletin board systems, some of which focus on specific science or technology topics. For example, IESD analysts sampled topical bulletin boards in the Denver, Colorado area and found BBSs for:

Astronomy
Computer Care
Earthquake Data
Electronic Professionals and Enthusiasts
Space Environment
Space Exploration Information

Telephone Homework Hotlines: A Model for Computer Network-based Tutoring Services

As home computers become more prevalent throughout the U.S., online homework help and tutoring services have great potential for providing academic support to students at home. Commercial services such as America Online and GEnie are currently providing such services. However, these require per hour charges that are likely to discourage significant use.

Free or low-cost, flat-rate access networks, such as Free-Net, Big Sky Telegraph, Learning Link, and (in some regions) the Internet, would provide an appropriate "home" for online homework help and tutoring services.

The best model for providing such services are telephone-based homework help services, available in some communities throughout the U.S. free of charge to local students. These

services are frequently organized by the local teachers union, the local school district, a regional education agency, or some combination of these organizations. IESD analysts identified 30 such services and investigated seven in depth:

Baton Rouge, LA
Bridgeport, CT
Indianapolis, IN
Los Angeles, CA
New York City, NY
Rochester, MN (serving the entire state of Minnesota)
Trumbull-Shelton-Stratford, CT

Five of the seven services report taking calls from students in elementary, middle/junior high, and senior high school (including one site that is only funded for elementary students). Two services are not prepared to answer questions from senior high students, due to funding limitations. Three sites specifically mentioned that they occasionally field questions from college students.

Where funding limitations do not restrict the range of students served, over half the calls are from middle/junior high students and older. Half or more of the calls from these students concern mathematics. Typically 5-10 percent focus on science questions.

When Homework Services Operate

Homework services are typically available Monday through Thursday. (One was available Sunday evening as well.) Most are in operation for 3-4 hours per day, within the time span from 3:30 p.m. to 9 p.m.

Staffing Issues

At every one of these services, the homework helpers are paid, licensed, practicing teachers. A few services have additional requirements (e.g., a masters degree, five or more years of teaching experience, passing a screening process for temperamental suitability).

All seven services require helpers to undergo initial training. Typically, training focuses on how to engage students in a dialogue that helps them through their problems without having the helper do the thinking for the student. Some services have trainees simulate actual

sessions or buddy with a working homework helper before working independently.

In four of the seven programs, junior and senior high students are automatically referred to subject matter specialists (e.g., a math teacher for math questions; a science teacher for science questions). At the other programs, the administration prides itself on the versatility of the helper staff. However, for questions requiring special expertise, students are referred to subject matter specialists. Typically, 40 percent or more of the helpers on call on any given day have special expertise in math, and at least 20 percent have science expertise. In some programs, a few teachers have expertise in both science and math. (In Los Angeles, 3 of the 8 math and science teachers are bilingual.)

The number of student queries per day varies greatly from program to program (from an average of about 35 calls per day in small-town Connecticut to an average of approximately 550 calls per day in New York City), reflecting the size of the available student population. Staffing ratios range from a low of .02 (2 helping teachers per 100 student calls) to a high of .15. The average staffing ratio is .08.

Helping teachers work from 3 to 9 hours per week -- an average of 6 hours per week.

Costs and Funding

Pay for helping teachers at the services investigated for this study ranges from $10 to over $25 per hour -- an average of about $18 per hour. (Pay rates in New York and Los Angeles are the highest.) Assuming that a homework helper service were in operation 120 days per year and teachers were paid at an hourly pay rate of $18, it would cost $6,480 per helper per year if the service were in operation for 3 hours per day and $8,640 per helper per year if the service were in operation for 4 hours per day.

Other costs to run homework helper services include:

* Administrator's salary
* Cost of clerical support
* Cost of computer equipment
* Cost of physical plant (if not an in-kind donation)

* Cost of reference library (if not donated by publishers)
* Publicity costs
* Telephone expenses

Initial start-up is typically funded through government or private grants. On-going funding is provided by the local school board, teacher associations, state or federal funds, and/or private donations (including in-kind donations).

How Homework Helper Services are Organized

Location of service. All of the services contacted for this report have the homework helper staff work at a central location. (We contacted one additional service, in Arizona, where they had tried to route students' calls directly to the helper teachers' homes and where teachers worked on a voluntary basis. This system failed after one year due to lack of teacher interest.)

Materials available to helping teachers. All of the services provide print-based instructional and reference materials that teachers can access as calls from students come in. These materials include:

* Teacher's editions of textbooks in all subject areas (the actual textbook series used in the region served)
* Encyclopedia
* Dictionary

Additional materials available to helper teachers at one or more of the services include:

* Almanac
* Maps and globes
* Contact information to refer students to a local library information service
* Homework helper service-developed materials focusing on frequently-asked student questions
* Teacher-developed materials

Time required per call. The typical interaction between student and helping teacher takes from 5 to 15 minutes. Some services report that calls from high school students concerning advanced topics can take more time -- as much as 45 minutes to an hour.

Questions Asked and Kinds of Help Provided

Math questions. Most mathematics questions fielded from junior and senior high students refer to problems assigned from a textbook or developed by the classroom teacher. Content areas and topics frequently mentioned include:

- Rounding
- Percents
- Fractions
- Decimals
- Factoring Equations
- Algebra
- Geometry
- Trigonometry (fewer calls than other topics)
- Calculus (fewer calls than other topics)
- Word problems (of all types)

Science questions. Science questions from junior and senior high students typically focus on the following content areas and topics:

- Life Science
- Earth Science
- Biology
- Chemistry
- Ideas for Science Projects
- General study help (e.g., where to look in a science textbook for specific information; use of the table of contents, index, chapter heading)

Relatively few questions are asked concerning Physics, perhaps because fewer students take Physics and these tend to be students who have demonstrated an aptitude for science.

Procedure for helping. Help to students most frequently comes in the form of a Socratic-style dialogue, in which the helping teacher asks a series of questions that eventually lead the student to the correct answer. When necessary, the helping teacher provides a general rule or procedure for solving the type of problem at hand. The student is expected to apply the rule. Representatives from the

homework helper services stress the inappropriateness of supplying students with correct answers.

Since homework helper services rely so heavily on Socratic-style dialogue, online networks offering such a service will require real-time communication capability. Without real-time communication, Socratic-style give and take between teacher and student is impossible.

Difficulties Faced by Homework Helper Services

Difficulties include:

* Raising funds to keep the service going
* Overcoming resistance (during the service's start-up period) from classroom teachers who are concerned that the helping teachers will replace them or will do the work for the students
* Screening for patient, caring, committed helping teachers
* Providing the service past 8 p.m., to satisfy the needs of older students

Innovations that have Improved Homework Helper Services

Valuable innovations include:

* CD-ROM access to reference materials
* Computerized logging and tracking of student calls
* Service-developed reference manual of typical math and science questions

Conclusions

The following conclusions are impressions based on our review of educational resources available via telecommunications and on discussions with experts in educational technology.

Computer-based telecommunications for educational purposes is still in its infancy. Despite this, there is a wide variety of appropriate applications, including e-mail, database searching, electronic reference tools, file transfer, conferencing, and simulations. However, relatively few math and science resources have been developed to date that are intended for students in grades 7-12 for use outside of a school context. This is an area of potential opportunity and growth.

Use of telecomputing for educational benefit in the home by students is limited. There is more use by college- and university-affiliated students (including students in grades 7-12 whose parents have a higher education affiliation) than others. Children of parents who work in high technology industries are also more likely to benefit from online services.

Potential for Increased Usage

Cost as a factor. The home use of online services by students is likely to increase with the availability of free or flat rate access. For students in grades 7-12, parents tend to control the access to networks when time-based fees or surcharges are involved. While most national, commercial networks are moving towards flat rate structures, the flat rates do not typically include the most desirable services for educational benefit in the home. (Prodigy is a notable exception.)

More and more low-cost state, regional, or community-wide networks are being formed across the country. Where such services are available and are publicized, students take advantage of them. Two important issues that must be faced are:

1. Funding for the expansion that must come with increased usage

2. Responsibility for and supervision of students who may be given access to resources that some adults feel are unsuitable for children (important when providing open access to the Internet)

Ease of use. The user interfaces of most online services and networks were not developed with children in mind. Friendlier interfaces, especially those designed specifically for children, are likely to stimulate increased usage. The trend towards easier-to-use interfaces has already begun.

Proliferation of low cost computers. Home computers have become a commodity product. Especially in the MS-DOS-compatible market, there are many quality brands available, which is causing prices to spiral downward. And because of the newer windowing operating environments (e.g., Microsoft Windows), MS-DOS computers are beginning to compete with Apple Macintosh in terms of ease of use -- causing Apple to keep its prices down.

As prices continue downward, home computer purchases are likely to increase. As the supply of home computers with modems increases, so may the demand for online educational services. This, in turn, may make such services more economically viable.

Trends to Watch

IESD analysts note the following trends regarding computer-based telecommunications and education.

1. On-line access to public library collections is likely to grow. In the future, more and more full text sources are likely to become available.

2. Networks that have traditionally been special purpose in nature are acquiring multiple features. General information services and special networks are converging. Meanwhile, the interest in local BBSs so evidenced in the 1980s has evened out, in favor of more connected and comprehensive services. Specifically educational services are likely to co-reside with consumer and business-oriented services.

3. More networks are providing mail exchange protocols and/or gateways to other networks. The use of the Internet as a low-cost mail carrier is growing rapidly.

4. More real-time educational activities are likely to be developed. We can expect that many of these will combine text-based communication with video-based communication. Cable television and telephone companies (providers of fiber optic connectivity) are becoming involved in such ventures.

5. Educational help services will be able to offer different modes of communication, including voice, fax, and text on computer screen. Some services may combine these types of communication.

SELECTED REFERENCES

Eiser, L. (November/December 1990) Keeping in Touch: A Guide to Online Telecommunications Services. Technology & Learning, pp. 36-43.

Kehoe, B.P. (1992) Zen and the Art of the Internet: A Beginner's Guide to the Internet. Brendan P. Kehoe.

Kochmer, J. (1992) NorthWestNet User Services Internet Resource Guide (NUSIRG), Third Edition. Bellevue, WA: NorthWest Net Academic Computing Consortium, Inc.

Kurshan, B. (December 1990) Home Market for Educational Online Services: Growth of Market and Strategies for Expansion.

Kurshan, B. (December 1990) Statewide Telecommunications Networks: An Overview of the Current State and the Growth Potential.

Kurshan, B. and Harrington, M. (November 1991) Creating Communities: An Educator's Guide to Networks. (Prepared for the National Science Foundation.

Mooers, C. (August 1991) Exploring Janet from the Internet. NSF Network News, No. 10. p. 5.

NSF Network Service Center (1989) Internet Resource Guide. Cambridge, MA: BBN Systems and Technologies Corporation.

APPENDIX

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Educorp Consultants, Inc.
Roanoke, VA
Phone: 703-774-0193
E-mail address[2]: Kurshan@VTVM1.CC.VT.EDU

Len Scrogan
Telecommunications Consultant
Educational Technology Specialist
Boulder Valley School District
Boulder, CO
Phone: 303-661-9132
E-mail address: 72065,1113 (Compuserve)

Online Services

America Online
Quantum Computer Services
Vienna, VA 22182
Phone: 800-227-6364; 703-448-8700

Big Sky Telegraph
Western Montana College
Dillon, MT 59725-3598
Contact Name: Frank Odasz
Phone: 406-683-7338

CARL Systems, Inc.
Colorado Alliance of Research Libraries
Denver, Co. 80210
Phone: 303-758-3030
E-mail address: help@carl.org

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2. E-mail addresses are for the Internet unless otherwise noted.

Cleveland Free-Net and the National Public Telecomputing Network (NPTN)
Cleveland, Ohio 44106
Contact Name: Tom Grundner
Phone: 216-368-2733
E-mail address: aa001@cleveland.freenet.edu.

CompuServe
500 Arlington Center Blvd.
Columbus, OH 43220
Phone: 800-848-8199

Connected Education, Inc.
New York, NY
Contact Name: Paul Levinson
Phone: 212-549-6509
E-mail addresses: levin@ddelpl.das.net
72517,3107 (CompuServe)

Cornell University Career Center
Auntie Em
Ithaca, NY
Contact Name: Tom Devlin
Phone: 607-255-5221

Delphi
1030 Massachusetts Ave
Cambridge, MA 02138
Contact Name: Robert Adams (Product Development)
Phone: 800-544-4005; 617-491-3393

Dialog Information Services, Inc.
3460 Hillview Ave.
Palo Alto, CA 94304
Phone: 800-3-DIALOG

EcoNet
Institute for Global Communications
A Division of the Tides Foundation
San Francisco, CA 94107
Phone: 415-442-0220

El Paso Community College
El Paso, TX
Contact Name: Mike Wolf
Phone: 915-775-6101

Florida Information Resource Network (FIRN)
Florida Department of Education
Tallahassee, FL 32399
Contact Name: Bebe Smith
Phone: 904-487-8668

GEnie
GE Information Services
Rockville, MD 20850
Contact Name: Sandra Meeker
Phone: 800-638-9636; 301-340-4310

Georgia College
231 West Hancock Street
Milledgeville, GA 31061
Contact Name: Frank Lowney
Phone: 912-453-5121

Learning Link/IntroLink
LinkNet, Inc.
New York, NY 10019
Contact Names: Robert Spielvogel; Erica Marks Panush
Phone: 212-708-3054; 212-708-3056
E-mail address: rspiel@linknet.com; llncem@linknet.com

North Dakota: SENDIT and the North Dakota University System
North Dakota State University
Fargo, ND
Contact Name: Gleason Sackman
Phone: 701-237-8109

NYSERNet
Bridging the Gap/Ask Liberty High Project
111 College Place
Syracuse, NY 13244
Contact Name: Linda Carl
Phone: 315-443-4120

Prodigy
Prodigy Service Co.
White Plains, NY 10615
800-776-3449

Texas Education Network (TEnet)
Texas Education Agency
1701 N. Congress Ave.
Austin, TX 78731
512-463-9734

Virginia Educational Research Network (VERNet) and Virginia Public Educational Network (VA.PEN)
Virginia Department of Education
P.O. Box 6Q
Richmond, VA 23216
Contact Name: Harold Cothern
Phone: 804-225-2921

Homework Hotline Services

Baton Rouge Dial-A-Teacher
Baton Rouge, LA 70808
Contact Name: Marian Baun
Phone: 504-766-6453

Connecticut Education Association
Bridgeport Education Association and
Trumbull-Shelton-Stratford Homework Hotlines
Bridgeport, CT
Contact Name: Jeff Rosenburg
Phone: 203-378-2101

Indianapolis Public Schools
Parents in Touch/Dial-A-Teacher
901 N. Carrollton
Indianapolis, IN 40202
Contact Name: Frances Richey
Phone: 800-232-6277; 317-226-4134

National Education Association
National Center for Innovation (information on homework hotline services)
Washington, DC 20036
Contact Name: Shari Castle
Phone: 202-822-7927

Southeast Minnesota Educational Cooperative Service Unit
Homework Helpline
Rochester, MN
Contact Name: Diane Fritcher
Phone: 507-288-1282

United Federation of Teachers/New York City Board of Education Dial-A-Teacher
New York, NY 10010
Contact Names: Betty Holmes and Grace Friedman
Phone: 212-598-9205

United Teachers of Los Angeles
Dial-A-Teacher
Los Angeles, CA 90057
Contact Name: Teresa Montano
Phone: 213-487-3739

Other

EDUCOM K-12 Networking Project
Washington, DC 20036
Contact Name: John Clement
E-mail address: JRC@BITNIC.BITNET

Additional Online Projects and Services

Ball State University
Muncie, IN 47306
Has developed an online student information system, which includes: an e-mail system for students to communicate with faculty advisors; a student information database (e.g., space available in a particular course); career services; and current student employment opportunities.
Contact Name: Hal Caldwell
Phone: 317-285-8686

Earth Kids Net BBS
Earth Kids Organization
P.O. 3847
Salem, OR 97302
A non-profit telecommunications service that focuses on ecology projects. One past project involved measuring CO_2 levels at local sites throughout the country; participants included students in middle through high schools, home schoolers, church groups, and graduate students. Has begun a new project in which participants study the local impact of ozone on frog populations.
Contact Name: Marshall Gilmore
Phone: 503-363-1896
E-mail address: marshall.gilmore@F606.n103.z1.fidonet.org

FrEdMail
FrEdMail Foundation
P.O. Box 243
Bonita, CA 91908
A network of bulletin board systems that includes educational projects and e-mail. The projects are intended primarily for elementary school students, but some are suitable for older students. Some projects involve math and science (e.g., a noon observation project, in which students at sites across the country measure the shadow cast by the sun at noon and then use the data to estimate the earth's circumference). While most of the system's activity occurs within schools, some students access FrEdMail at home to communicate with others and to obtain answers to questions.
Contact Name: Al Rogers
Phone: 619-475-4852
E-mail address: arogers@bonita.cerf.fred.org

Laptop Take Home Project
New York City Board of Education (NYCBOE), Bureau of Non-public Schools
Brooklyn, NY
Provides access to online remedial math and reading instruction (an integrated learning system) to non-public school students at home. (The project is funded under the U.S. government's Chapter I remedial education program.) Each student is loaned a laptop computer equipped with an internal modem; the computers have been customized so that they work only with the NYCBOE's telecommunications software. Besides accessing instruction, each student can send and receive e-mail to a NYCBOE teacher, who is responsible for monitoring progress. The project covers grades 1-8, with approximately 200 students on the junior high level. In addition, some homebound NYCBOE public school students use the same system but have access to a greater variety of courseware.
Contact Name: Margaret Weiss
Phone: 718-935-4162

KIDSNET Mailing List
c/o University of Pittsburgh
Physics Department
Pittsburgh, PA 15260
A good source of information about news and e-mail interfaces suitable for children's use, and online services for the K-12 audience. Subscribers include teachers, administrators, scientists, developers of software and hardware, and funding agencies.
Contact Name: Robert Carlitz
Phone: 412-624-9027
To Register: kidsnet-request@vms.cis.pitt.edu or
joinkids@vms.cis.pitt.edu

KIDLINK, KIDLEADER, KIDPROJ, KIDPLAN, and
KIDCAFE LISTSERV Lists
A set of information resources and a source of projects organized around the idea of a global telecommunications network dialogue for youth aged 10 to 15.
Contact Name: Odd de Presno
Saltrod, Norway
Fax: +47-41-27111 (an international exchange)
E-mail address: opresno@extern.vio.no

MicroMuse at MIT
Massachusetts Institute of Technology
Cambridge, MA
A multi-user, text-based, simulation environment based at MIT's Artificial Intelligence Lab, providing explorations, adventures, and puzzles that combine social, cultural, and educational content. Examples include: the MicroMuse Science Center, which provides interactive exhibits based on experience with Science Museums around the country; a detailed tour of Mars; and a working model of a futuristic version of Yellowstone National Park. The centerpiece of MicroMuse is Cyberion City, a simulated orbiting space station that exists in the 24th century.
To Register: micromuse-registration@chezmoto.ai.mit.edu

MIT Plasma Physics Lab
Massachusetts Institute of Technology
Cambridge, MA
Teaches a course in non-linear dynamics to high school students over the Internet.
Contact Name: George Johnston
E-mail address: glj@nerus.pfc.mit.edu

New York Network/State University of New York (SUNY)
Albany, NY 12225
Has formed a public/private partnership with Instructional Systems, Inc. (ISI), of New Jersey, to research and develop a service that integrates widely available learning technologies to provide instruction to homes, the workplace, and community sites. Technologies include computer-based telecommunications (to provide an integrated learning system), cable television (to provide a live teacher), and telephone (to allow for student communication with the teacher).
Contact Name: Gregory Benson, Jr.
Phone: 518-443-5333

NovaNET
Computer-based Education Research Laboratory (CERL)
University of Illinois
Champaign-Urbana, IL 61801
A network accessible via phone lines or satellite that offers a continuously updated library of interactive educational software. (The system is the higher-technology successor to the original PLATO integrated learning system.) There are currently 90,000 users in 13 states, and at some locations, the network can be accessed via home computer. Over 10,000 hours of instruction are available on the network, ranging from elementary level through post-graduate education, in a wide variety of subjects (including job training).
Contact Name: Lorella Jones
Phone: 217-333-1138

Project Homeroom
c/o Ameritech Corporation
2000 West Ameritech Center Drive
Location 4B35C
Hoffman Estates, IL
An experimental project developed by IBM, Ameritech Corporation, and Illinois educators, in which students and teachers use computers at home that are linked via special (ISDN) telephone lines to a school local area network (LAN). The system also provides access to Prodigy's e-mail and online encyclopedia. The project is designed to foster cooperative learning among students and to encourage out-of-class teacher-student and teacher-parent communication. Another goal of the project is to introduce interdisciplinary instruction.
Contact Name: Gene Dunne, Ameritech Corporation
Phone: 708-248-5404

Rochester Institute of Technology
P.O. Box 9887
Rochester, NY 14623
Offers online bachelors and masters degree programs, including science, applied computing, telecommunications, and software development and management.
Contact Name: Susan Rogers
Phone: 800-CALLRIT; 716-475-5089
E-mail address: smrasv@isc.rit.edu

Virginia Tech
Blacksburg, VA 24061
Has developed an online program called "Study Smart," providing study skills for middle school and high school students (distributed by America Online). Currently developing a college version, which will be available over Virginia Tech's on-campus network.
Contact Name: Thomas Sherman
Phone: 703-231-5598

Additional Resources

Ecolinking
Peachpit Press, Berkeley, CA
A how-to book for using telecommunications to access ecology information.
Author: Don Rittner

Electronic Networking: Research, Applications and Policy
A journal published by Meckler Corporation.
Westport, CT 06880
Phone: 203-226-6967
E-mail addresses: meckler@jvnc.net
70373,616 (Compuserve)

Exploring the Internet: Searching for K-12 Resources
Connecting Schools Task Group of the Massachusetts Telecomputing Coalition
580 Whetstone Hill Road
Somerset, MA 02726-3702
A publication covering the basics of Internet use, including: what you need to get started (including hardware and software requirements); understanding Internet addresses; accessing remote computers; e-mail; and file transfer.
Contact Name: Martin Huntley, Computer Technology Center
Phone: 508-672-2060
E-mail address: mhuntley@umassd.edu

Laptop Notes
c/o Bank Street College of Education
New York, NY 10025
The newsletter of the Panasonic Laptops for Education Project.
Contact Name: Katie McMillan (Bank Street College)
Phone: 212-875-4400

"Linking for Learning: Computer-and-Communications Network Support for Nationwide Innovation in Education," Journal of Science Education and Technology, Vol. 1, No. 1, March 1992.
An overview of the planned future of the National Research and Education Network (NREN), which seeks to provide a telecommunications link between the educational and research communities throughout the country and the world, to support educational reform.
Author: Beverly Hunter, National Science Foundation, 1800 G St. N.W. Washington, DC 20550

National Universities Degree Consortium
Colorado State University
Spruce Hall
Fort Collins, CO 80523
Works with and tracks universities that provide technology-based distance learning (including computer-based telecommunications) to homes and workplaces. They are especially interested in encouraging and helping universities to provide baccalaureate degree programs via distance learning.
Contact Name: Joan Bowen
Phone: 303-491-5288
Voice Mail: 800-688-6245 (at the sound of the recorded voice, press 2, then extension 7070).

National University Continuing Education Association
1 Dupont Circle, Suite 615
Washington, DC 20036
Publishes the Directory of Distance Education through Telecommunications, which identifies universities that are providing instructional services using a variety of telecommunications technologies.
Contact Name: Noah Brown
Phone: 202-659-3130
Fax: 202-785-0374

Old Colorado City Communications
6 North 24th Street
Colorado Springs, CO 80904
Provides a variety of services related to educational applications of online technology, including: a network from which educational services can be provided and accessed; consulting on the development of educational telecommunications systems; development and ongoing administration of online instruction; instruction on how to use telecommunications and the Internet, and how to teach online; and consulting on government policy related to educational technology.
Contact Name: Dave Hughes
Phone: 719-636-2040